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Review of green electricity production in Slovenia

U. Stritih, G. Zupan, V. Butala*

Center for Energy and Environmental Technologies, Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, 1000 Ljubljana, Slovenia

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Abstract

The article presents a short review of electricity production from renewable energy sources in Slovenia. In Introduction the term of "green electricity" is defined. Comparison of structures of electricity production is presented for the years 1990 and 2003. The main part of the article presents an approximate data for technical and theoretical potentials of renewable energy sources in Slovenia. State-of-the-art regarding individual technologies of electricity production from renewable energy sources and political targets according to Directive 2001/77/EC for green electricity are also presented. At the end of the article different stimulation models are described and uniform prices and premiums for the purchase of green electrical energy are presented.

Keywords: Electrical energy; Renewable energy sources

Contents

*Corresponding author. Tel.: +386 1 4771 421; fax: +386 1 2518 567.
E-mail address: Vincenc.butala@fs.uni-lj.si (V. Butala).

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1. Introduction

The Republic of Slovenia became a member of European Union (EU) in May 2004. With a membership in EU Slovenia adopted European legislation a part of which is also a Directive 2001/77/EC [1]. The purpose of this directive is to promote an increase in the contribution of renewable energy sources (RESs) to electricity production in the internal market for electricity and to create a basis for a future Community framework thereof.

In Slovenian legislation the term green electricity has not been defined although this term is used in technical as well as by the wider public. Green electrical energy is that at which production there are no greenhouse gas emissions, there are no influences into space or is as small as possible and also otherwise does not disturb the environment. This is mostly the electrical energy produced by RESs. Electricity produced by fossil fuels is also added up to green electricity if a very high efficiency is reached. Limited greenhouse gas emissions, especially carbon dioxide and nitric oxides are also an additional condition that add up to green electricity.

2. Structure of electricity production in Slovenia

RESs are the most important primary energy source in the long-term period in Slovenia. By share of electrical energy production from RESs, Slovenia belongs among the most developed European countries. Big hydro power plants contribute the biggest share to that fact. Without big hydro power plants (above 10 MW) the Slovenian situation is a lot worst since Slovenia belongs among the worst-developed European countries. The beginning of small hydro power plants production in Slovenia was at the start of 1980s stimulated by an Energy Sector Act, which allowed construction of energy buildings also out of electricity management. In this way until attainment of independence the greater part of small hydro power plants was built.

Production of electricity in Slovenia is divided into three parts. These are nuclear energy, energy from fossil fuels and energy from RESs. Power plants on fossil fuels represented the major part of all electricity production in the year 1990 in Slovenia (Fig. 1) [2]. Nuclear power plant (only one in Slovenia) represented the second highest part of all electricity production. Electricity production from renewables was 24% which includes big hydro power plants. The latest represents almost all RESs for electricity production in Slovenia.

Situation about electricity production from RESs in Slovenia has improved in the last few years. Fig. 2 shows increased electricity production from RESs for 1 PJ for the year 2003 in comparison to the year 1990. Small hydro power plants show the highest share of increase in the field of electricity from RESs. This is due to much more plants in comparison to the year 1990. But big hydro power plants represent smaller electricity production in comparison to that year. This is because of a very dry and hot Summer.

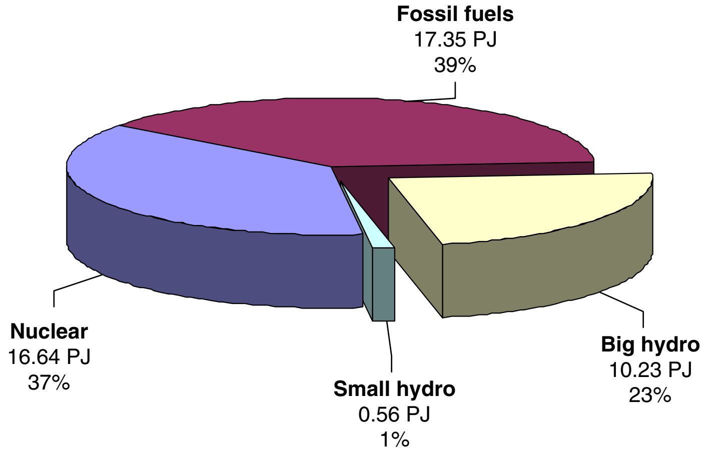


Fig. 1. Structure of electricity production in Slovenia in the year 1990.

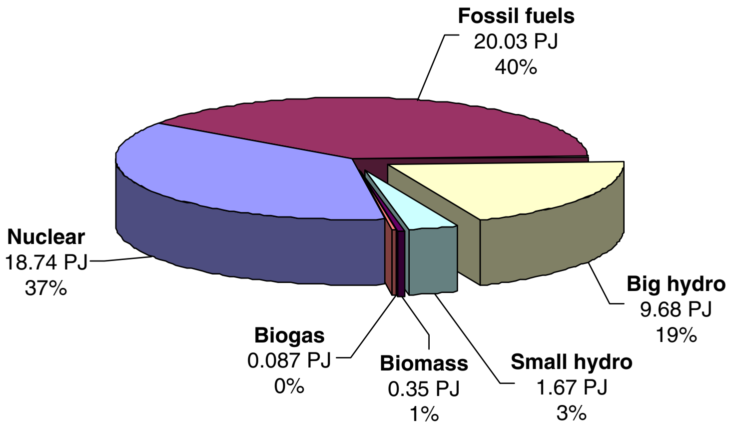


Fig. 2. Structure of electricity production in Slovenia in the year 2003.

Biomass and biogas represent new parts in electricity production in comparison to the same year 1990.

3. Technical and theoretical potential for electricity production from renewables

All potentials of RESs for electricity production in Slovenia have not been utilized yet. There are some definitions of potentials of RESs:

- Theoretical potential is the whole potential of the individual RES and cannot be practically utilized.
- An available potential is a technical potential which can be utilized with momentarily reachable/known technologies. The available potential is smaller than the theoretical potential.

Table 1
Technical and theoretical potentials for electricity production from renewable energy sources

Renewable energy source	Technical potential (PJ/a)	Theoretical potential (PJ/a)
Wind	—	55
Large hydro (>10 MW)	30.1	69.84
Small hydro (<10 MW)	2.66	
Solar energy (for heat and power)	3.456	19,200
Biomass	4.46	27.9
Biogas	1.544	25.4
Geothermal energy (for heat and power)	10	19.6

- An economic potential is a potential estimated on the basis of economic criteria. An economic index has to be selected and its value has to be defined here. The economic potential is smaller than the available potential.

A lot of studies have been made which estimate potentials for new-qualified power plants. But estimated potentials are differentiated greatly and the main problem is mixing of theoretical and economic potentials.

In Table 1 the technical potentials for electricity production from RESs are presented [3,4].

4. Electricity production and political targets according to Directive 2001/77/EC

Momentarily the share of RESs in total primary energy balance is 10.8% (data for the year 2003). The share of RESs in total electricity is 23.2% (2003). National target in accordance with Directive 2001/77/EC for RESs in total electricity is 33.6% including big hydro (till 2010) or 4.2% excluding big hydro (2010) [5]. State-of-the-art regarding individual technologies of electricity production from RESs is presented below:

- *Wind turbines*: Today only one wind power plant operates on Kredarica, but produced electricity is not being sold to the network. In the year 2004 green light for setting up of 47 wind turbines on Volovja Reber was given. Their power should be 40 MW and annual produced electricity should be 120 kWh. A short-term perspective is realization of setting up of wind power plants on Volovja Reber with common power of 40 MW.
- *Wood biomass*: Case study about cogeneration on wood biomass in Heating Plant Železniki has been made, where planned spreading of network is already in operation and proposals for reduction of temperature level of the system are investigated. A short-term perspective is realization of cogeneration system in Heating Plant Železniki for which decision about technology (wood biomass boiler + steam turbine) is already excepted. Mid/long term perspectives are exchange of old, big industrial wood biomass boilers with new ones for combined heat and power production and building of new combined heat and power systems. Since investment costs for power plant on wood biomass are very high, it is estimated that power plants of common power of 8–10 MW can be built in Slovenia.

- *Biogas*: Presently there are three power plants on landfill gas from dumps of 4.55 MW of common power, two power plants on biogas from pig farms of 0.57 MW of total nominal power and four power plants on sewage sludge gas from wastewater treatment plants of approximately 1.8 MW of common power. Estimated economic potential from existent dumps, existent and planned waste water treatment plant in cities and animal farms is 10–30 MW by the year 2010.
- *Hydro*: Presently big hydro power plants with the capacity of approximately 831 MW and small hydro power plants with the capacity of approximately 155.54 MW are installed. A long-term perspective (2018) is the construction of five hydro power plants on Sava: Boštanj, Blanca, Brežice, Krško and Mokrice. Those hydro power plants will double electricity production on Sava with the total power of 187 MW.
- *PV*: A first solar power plant for electricity production with power of 1.1 kW, which is connected to electrical network, was set up in Ljubljana. On the faculty of electrical engineering and computer science in Maribor a 5.5 kW solar power plant which will be connected to electrical network have started to operate in the year 2004. The biggest solar power plant in Slovenia (16.3 kW) which is connected to electrical network has started to operate in the year 2005 on the roof of airport Lesce. A short-term perspective is setting up of some small independent systems, as well as systems connected to electrical network. However solar power plants will not influence essentially the share of produced electricity from RES.
- *Geothermal energy*: In Slovenia geothermal energy has not utilized for electricity production yet in spite of 50–70 MW_e of estimated theoretical potential. Short-term perspectives are studies for electricity production from geothermal energy.

5. Costs and subsidies for electricity production for RESs

The financing of electricity production from RESs in Slovenia is defined by the feed-in tariff for the project connected to electricity network and the subsidies of the project without any connection to electricity distribution network [6].

Valid financial mechanisms to support of projects of electricity production from RES are divided into public (state) financial shames and private financial schemes. Public financial schemes in support of projects of electricity production from RES are:

- Soft loans from ecological fund of the Republic of Slovenia,
- Subsidies of RES-e projects without connection to electricity network: case studies,
- Feed-in tariff system,
- Climate change levy.

Private financial schemes are momentarily limited on third party financing (TPF).

5.1. Soft loans

The ecological fund of the Republic of Slovenia (Eco fund) supports soft loans for investment cost of power plants, which produce electricity-using RES.

The financing support for the investment in RES-e projects is given by the ecological fund of the Republic of Slovenia. Ecological fund supports the RES-e projects by soft loans.

Name	Ecological fund of the Republic of Slovenia
Region available	Slovenia
Funding target	Electricity production using RES (biomass, geothermal and hydro energy, solar, wind)
Funding conditions	For local authority and all legal entities
Comments/contact	The soft loan is limited to cover up to 40% of eligible investment cost for large-scale companies and 50% of eligible investment cost for small and medium companies

5.2. Subsidy of RES-e project without connection to electricity network

Ministry of the Economy supports the electricity production from RES (wind or solar electricity plants) without connection to electricity distribution network through its public competition.

Name	Ministry of the Economy Subsidy of investment cost of electricity production from RES for project which will not be connected to electricity network
Region available	Slovenia
Funding target	Wind and solar power plant
Funding conditions	For autonomic power plants
Comments/contact	Subsidy is 30–40% of investment Subsidy will increase for 10% of investment for small and medium companies Subsidy will increase for further 10% of investment if the production heat of the plant is the only heat supply source in rounded off region The amount of money for subsidies for all investments in renewable energy projects is limited by the budget and every year defined by the Ministry of the Economy

5.3. Feed-in tariffs

The government adopted a decree and order (on 14 March 2002) on the price and premium for the purchased electricity from the qualified producers (or electricity from RES) [7]. The order defines the premium (subsidies) for electricity from all RESs (small hydro, biomass, wind, geothermal, solar, waste and all other RES) for power plants with capacities up to 10 MW as shown in Table 2.

The uniform prices (system) are same (constant) prices and premiums all the time. The varying prices system defines the prices and premiums based on the seasons and daily hours of electricity purchase. The varying prices and premiums are calculated as the uniform prices and premiums multiplied by the factors in Table 3.

Table 2
Uniform prices and the premiums for the purchase of electricity from qualified producers (year 2004)

Type of qualified power plant (QPP)	Capacity	Tariff (€cent/kWh)	Premium (€cent/kWh)
Small hydro power	Up to 1 MW	6.15	2.81
	Over 1–10 MW	5.93	2.60
Biomass QPP	Up to 1 MW	6.95	3.63
	Over 1 MW	6.74	3.40
Wind PP	Up to 1 MW	6.06	2.73
	Over 1 MW	5.85	2.52
Geothermal QPP		5.85	2.52
Solar PP	Up to 36 kW	37.36	34.03
	Over 36 kW	6.44	3.11
Others (including biogas)		12.07	8.73
Combined CHP and RES	Up to 1 MW	6.68	3.35
CHP use waste as fuel (including landfill gas)	Up to 1 MW	5.30	1.97
	Over 1–10 MW	4.94	1.61

Table 3
Multiplication factors for uniform prices and premiums

	HT	LT
HS	1.40	1.00
MS	1.20	0.85
LS	1.00	0.70

Here:

- HS—high season (January, February, December).
- MS—middle season (March, April, October, November).
- LS—low season (May, June, July, August, September).
- HT—high tariff rate (all days except Sunday) in the Winter time from 6 to 13 and from 16 to 22 and in the Summer time from 7 to 14 and from 17 to 23.
- LT—low tariff rate take (all days except Sunday) in the Winter time from 13 to 16 and from 22 to 6 and in the Summer time from 14 to 17 and from 23 to 7 and all hours on Sunday.

5.4. Climate change levy

The Ministry of the Environment, Spatial Planning and Energy yearly gives a public competition for exemption from CO_2 taxes in case of fuel switching from fossil fuels to RESs. The exemption from CO_2 taxes is limited to a share of eligible investment cost of the project and by limited total fund of the public competition.

5.5. Third party financing

TPF covers a wide variety of contracting and financing techniques for energy efficiency and renewable energy projects. Its basis is represented by the following two

approaches:

- *Energy performance contracting* (*EPC*) aims at reducing energy requirements and the contractor's remuneration is based on the cost savings achieved.
- *Delivery contracting* (*DC*) is meant for the investments in facilities used for energy conversion at the clients, where contractor's remuneration is based on the delivered heat, electricity and/or cool. As the projects from Europe show, e.g. from Berlin, this approach is also an appropriate financing tool for the newly installed equipment for producing heat and/or electricity from *RES*.

TPF market in Slovenia is at the moment slowly evolving and until now one EPC project and no DC projects are realised. There are some domestic TPF providers interested especially in EPC projects in the public sector, while foreign *energy service companies* (*ESCOs*) until now have not shown too much interest to get involved, which might be partly due to the small market. It is expected that in the beginning DC projects in Slovenia are going to be orientated especially towards installation of cogeneration systems, though the systems for producing electricity from RES are, of course, not excluded from the possible range of projects.

6. Conclusions

Slovenia has very limited energy resources of its own. The main sources for electrical energy production in Slovenia are fossil fuels and nuclear power, while renewable energy sources (excluding big hydro power plants) represent a very small part. Besides renovation an old hydro power plants and construction of a few new one, the main potential is indicated in the field of combined heat and power from biomass and construction of wind power plants. Due to very high potential of animal waste, a big emphasis will be also given on electrical energy production from animal waste. For stimulation of electrical energy produced by renewable energy sources, a feed-in tariff system as well as subsidies and soft loans are the most suitable mode. Because the share of electrical energy produced by qualified producers in Slovenia is small and it has not been increasing in the last 10 yr, the Green certificate is not a suitable system momentarily. When the share of the qualified electrical energy increases, this system will be more suitable because of the possibility of international trading.

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